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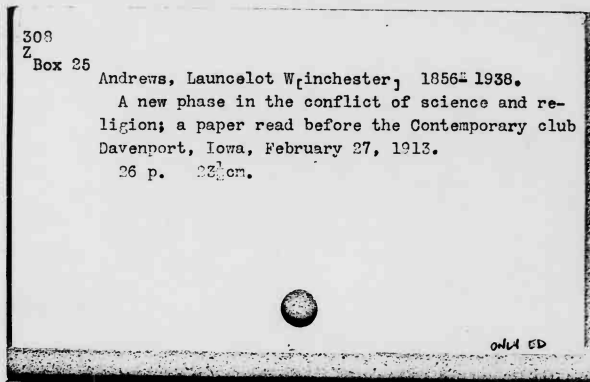
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Prof. J. McK. Cattell

# A New Phase in the Conflict of Science and Religion

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A Paper Read Before  
The Contemporary Club  
Davenport, Iowa  
February 27, 1913

By Launcelot W. Andrews

1913  
The Contemporary Club  
Davenport, Iowa

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## A NEW PHASE IN THE CONFLICT OF SCIENCE AND RELIGION.\*

BY LAUNCELOT W. ANDREWS.

When those among us were young, upon whom Time has now placed his silver stamp, the air was trembling with the noise of a conflict in the clouds. This conflict was called "The Warfare of Science and Religion," but might have been better named "The War of the Scientists and Religionists." The dragon's teeth from which this warfare sprang were sown with the first steps in organizing human society.

The social order is a machine and, like every machine, consists of two functionally distinct elements, the static and the dynamic. In the machine, the static element is the framework which correlates the other parts and maintains stability, while the dynamic element is made up of the moving parts which impart the capacity for change, and hence for work. The static or conservative element in the social order is that body of ethical or moral ideas and traditions which we denominate Religion, while the dynamic element is the summation of man's experience with nature, of his knowledge of phenomena, of his technical information, of his objective social history, things which, taken together, we call Science.

From the earliest beginnings of science, onward, the scientists have been the pioneers of society and have exhibited the characteristics of pioneers, in their keen interest in the new, in their disregard of the old, in their readiness to risk the goods already in hand for better goods dimly seen on the horizon, and in their disesteem—underappreciation—of everything conservative. One can easily imagine, that, if the parts of a machine were conscious, the moving members would look upon the stationary stability of the frame with a certain contempt and, resenting its restraint, might even regard it as a thing superfluous, as an obstacle in the way of free movement.

\*Read before the Contemporary Club February 27, 1913.

The religionists, on the other hand, conscious of their conservative function, must regard themselves as the responsible custodians of an inheritance threatened by every change and by every disturbance of the social order and must, on principle, oppose a new thing, until it has proved its value; by which time it is of course no longer new. So we find, the scientists always trying to induce the people to do something that they have never done before, while the religionists are urging them to keep out of danger and to return to a model of the past, that is, to imitate the example set by the founders of the several sects.

From this point of view, there must always be a conflict between science and religion, but a conflict only in the sense of an action and reaction, a mutual pressure exerted by each upon the other.

Religion is the fulcrum and science the lever, which together raise mankind.

How trivial, then, is the view which would construe the pressure so exerted in terms of a *quarrel*! What need for heat? A good machinist, when the bearings of his machine get hot, puts oil upon them, and the good sense of man has poured much oil on the points of contact between science and religion since the days of rack and stake, and even within the memory of many who are here to-night.

But the great improvement in tone which marks the controversy between the religionists and scientists of to-day, as contrasted with that prevalent thirty or forty years ago, is not the feature to which your attention is invited this evening. Not only the tone of the conflict has changed, but its ground has shifted. Both parties have changed their positions. The religionists no longer dispute the verdict of the scientists in scientific matters, and the scientists have abandoned the position that "Matter holds the Promise and Potency" of all things in the universe, and now assign this "Promise and Potency" to energy, regarding matter merely as a symbol of thought.

Now, the concept of energy is a good deal more closely related to that of spirit than is the concept of matter, so that it has become easy for the scientists so to extend the bounds of their own field as to claim all that which was formerly regarded as the exclusive

domain of religion. To make this new position clear to you, I might attempt to give you a bird's-eye view of the utterances of several recent scientific writers, to construct a composite picture, so to speak. But to do this clearly, in the time allotted me, would be quite impossible, so that I have perforce elected a different procedure, namely, to present in outline the views of a single author, selected as highly typical of the modern drift of thought along these lines.

The writer chosen for this purpose is the very distinguished scientist, Wilhelm Ostwald, formerly for many years professor at the University of Leipzig, and now editor of the "Annalen der Naturphilosophie."

In what follows, it shall be my aim to lay before you a brief summary of the position taken by Ostwald on the relations of science to religion, in a manner as devoid as possible of any color reflected from my own views. With this object, I shall not break into the presentation by any comment or criticism, and shall follow Ostwald's own phraseology so far as may be compatible with the necessary condensations or omissions.

Self-respect and happiness are, in the last analysis, the motives of human conduct in those things that lie beyond mere maintenance of existence. To these wealth is but a means. In fact, the greatest of all happiness, which can come to a man in advancing years, is to diffuse happiness about him by the production of creative ideas which relieve mankind of part of their heavy burdens and increase the general opportunities for happiness. If this highest be denied him, it is for him to find other ways of diminishing the obstacles that lie in the way of the development and of the practical application of such ideas.

The creative ideas which bring happiness most directly are, in the first line, those furnished by science, for science lessens or removes many forms of disease and misery which plague or threaten man in consequence of his biological relationships. What no one of the many religions has been able to do has been accomplished by science in an ever increasing degree, in bettering those conditions of life which make for happiness, not alone through the advance of medical knowledge in the treatment of disease, but still

more in teaching man how to minimize the causes of disease. The surprising extension of the span of human life, within a few decades, is an index of what has already been attained in this direction.

How much richer, not only our external, but also our inner lives have become, through technical developments that rest absolutely on scientific progress is evident from the fact that to-day anyone can buy, at a small price, the works of the best thinkers and poets and excellent reproductions of works of art. He may usually enjoy them without cost, by using public libraries and art museums. Thus, a fruitful stream, bearing all manner of opportunity for mental and esthetic culture flows among the people.

Yet more deeply does science now influence the inner life of man. Self-respect has already been alluded to as holding first place among the conditions that make for happiness. "Self-respect" is here used to designate a freedom from all conflict between the thinking and the doing, between "I will" and "I must." No religion can impart this highest good of mankind, this deep harmony which can withstand all vicissitudes of life. This results from the circumstance that every religion must make the mode of thought of its founder into a fixed and permanent standard for all believers. Now, however high this founder may have been able to raise himself above the level of his contemporaries, and it must have been far for him to have become such a founder; he must have stood on the basis which his time furnished, otherwise he could have had no important influence on his contemporaries.

Again, to science we owe our recognition of the evolution of the human species and of its continued advance to higher and higher planes of thought and feeling. This recognition involves the corollary that every religion, in proportion as it becomes older, puts itself more and more in contradiction with the science of the present.

Protestantism is nothing else than a four-century effort to accommodate the content of the Christian religion to the time, more fully than was possible with the Romish church. This form of religion succeeded, accordingly, for several hundred years in meeting the needs of the masses, but not so completely those of more

advanced religious thinkers. Here, again, the tendency to become outgrown, which is inherent in every religion, became irresistible, and a sense of the conflict disturbed the conscience, alike of the most spiritually minded and of the multitude.

In contrast with this inevitable, necessary, growing-old of all religions, science shows itself of another character, as being eternally young. Since with her, no condition, no cognition, is ever regarded as final or as unalterable, and since everything is constantly subjected to a ceaseless, conscientious criticism, errors may indeed occur, but they can not become firmly fixed. "Inner self-respect," the unshakable determination to tolerate no internal contradiction, is her life's element and the condition of her existence. Hence she must, as against death, defend herself against every attempt to limit the right of criticism, that is of scientific investigation of anything whatever, under the obligation of absolute sincerity.

None will deny that science has not always been conceived in this high sense, but the religions have fallen still further short of their standards, because they have not contained the source of self-betterment, which science possesses in the principle of free criticism.

It is of interest to inquire, how it comes that most religions place the Paradise or Golden Age in the past and teach that man has become worse through sin, while science teaches that savagery, cruelty, blood-thirstiness, murder, and cannibalism are greater as we go backward in the history of mankind, and points to the future, not to the past, as the Golden Age. How does it happen that the opposite view has been so general?

The answer is to be found in the attitude of the aged toward the time of their own youth. The old, almost without exception, think that the period when they were young was better, the weather more brilliant, the apples more tasty, the bread their mother's made finer, and the boys more industrious than is the case now. This is not difficult to account for, on the ground of the impairment of the keenness of all organs of sense and the enhanced habit of criticism which age brings.

The early writers, who presented views on such subjects, were naturally old men, for the young have but little inclination for such activities. It comes, then, that the attitude of the aged toward the past, tinged as it is by the limitations of age, has very often been accepted as representing an historic fact with regard to the past. Ancient literature is permeated with this myth. The influence of the myth on the religions of the world has been potent. Admitting that the world has become worse, a necessity is felt to account for the supposed fact by assuming the existence of a personal evil agency, to whom was due the introduction of evil. There is in the religions, accordingly, a marked note of pessimism.

The natural world is entirely filled with cruelty, roughness. It is the theatre of the wildest selfishness, in which the balance between the beings who people it is preserved only by their devouring and destroying one another. There, only the battle for existence, described so well by Darwin, rules. Man is the only being we know in nature which makes himself more and more free from the tyranny of this conflict and provides for existence by peaceable work. He alone seeks to heal sickness and to aid the feeble. The results of the good which he does are not restricted to himself and to the recipient, since as a result of a known biological law, every time such conduct is practiced the easier it becomes, not to the individual only, but to all his descendants. That man is most *man* who most consistently practices love and kindness in a world of egoism.

Art, religion, and science, the three forms of human culture, have sometimes been arranged as of co-ordinate worth, sometimes with one or the other in the highest position, the third beneath. This question can be attacked by the aid of a biological law, which teaches that, in the individual as in the species, the organs which first develop are of the more primitive type. Similarly, in the progress of human society, the forms of human activity are crude in kind in proportion as they are prior in time, the higher forms succeeding the lower. Hence, religion, granting that it is, as it claims, the oldest cultural activity of man, is thereby characterized as the most primitive. Of moment here, is the intimate bond of union with the past which is common to all religions and which infallibly leads

them between Scylla and Charybdis. Either they hold fast to the old (and the gap between it and the needs of the present yawns ever wider), or, they hesitatingly follow the call of those needs, in which case they surrender the basis of their existence, their claim to stand above mundane or human criticism, and subject themselves to the judgment of science.

In early times, when mere existence was so hard a problem that progress could not be thought of, religion, with its fundamental principle of *stability*, was the most advantageous form of culture. Later, when the more primitive substructure of civilization had been secured by the fixative power of religion, the same conflict arose which afterward appeared in many branches of science, namely, an unescapable contest between the practical requirement of self-preservation, on the one hand, and, on the other, the distinctively human thirst for betterment and progress. Furthermore, those classes or individuals which enjoy special privileges or advantages, turn to the church as the preserver of the *status quo*. In fact, the church can so act, but only temporarily, until the disproportion between reward and merit has become so glaring that the unprivileged classes will endure it no longer. Retardation of progress leads to revolution, and to that extent the church is as naturally the source of revolutions as science is of peaceful development. The church is unable to prevent progress, but can and does suppress the symptoms of progress. This is tantamount to screwing down the safety valve on a steam engine and hiding the steam gauge.

Recent history affords many instances in Roman Catholic lands. It is noteworthy that in the Protestant countries of northern Europe, the monarchy remains unthreatened, whereas in most of the Catholic lands republics have, by revolutionary methods, supplanted the monarchs. Recently, in Norway, as the free choice between monarchy and republic was presented to the people, they chose the former.

The foregoing considerations make clear a certain relation between science and religion. The farther back we go in civilization the more valuable we find religion to be. The further we rise in it the more does religion retire into the background, giving place to science.

Can religion ever become superfluous?

The answer to this question, which Ostwald makes, is, that one stratum of the people after another raises itself out of the ocean of religious conceptions, and that the movement toward the superfluity of religions is a gradual one, of which it is impossible to predict the date of completion, inasmuch as a considerable portion of the human race is on so low a level of cultural capacity as to make it doubtful whether they will ever reach the highest plane. These will surely have a need for religions and will maintain them.

In this sense are to be understood the words of Goethe:

"He who has Science and Art  
Has Religion, also,  
He who has neither of these,  
Let him have Religion."

All religions maintain that the contents of their scripts and tenets constitute the truth, and that no human or mundane knowledge can claim this designation, since it is, at best, artificial and confessedly imperfect. On the other hand, the various religions contradict one another, each claiming for itself absolute truth as its exclusive possession in many and important points. Hence follows the conclusion that the claims of the several religions to the possession of the absolute truth, neutralize one another and become invalid.

Again, we must turn to human knowledge, and ask whether *it* can lead us to the truth or near to it. Here we find the picture reversed. Whereas, the religious conceptions, claiming the truth for their own, separate in course of time further and further from one another (witness the splitting of the Christian church into three great branches, Greek Catholic, Roman Catholic, and Protestant, and the further schism of the last into innumerable sects) so, on the other side, the laws and concepts which science accepts as true, come, in course of time, ever closer together. The rotation of the earth about the sun, stigmatized as false by the dominant religion, was not on that account abandoned by science as a truth. Historically speaking, science has always maintained its stand, while it has ever been the church which yielded to the decision of science, sometimes after long waiting. The most orthodox priest would not now venture to deny the Copernican theory, and would not be seriously taken by his followers if he did.

It lies in the nature of the influence exerted by science on the aspect of life; that the religions must drop their old concepts in proportion to the measure in which the spirit of science permeates the people.

It can not be otherwise than that science should gradually supersede the religions when it comes to investigating the truth. When man made his first attempt at comprehension of the chaos of the world, the sum of such thoughts, constituting the germs of that which we now call poetry, science, religion, technology, was all put in one basket. The early bearers of the torch of culture were priests, doctors, rulers, judges, all in one. That was quite possible, since the sum total of intellectual possessions was not very great and might find commodious lodgment in a single head. With growing specialization, some of these functions were of necessity delegated to certain classes. The position of first comer and the prestige of tradition long enabled the priesthood to still reserve to themselves the functions of government.

The source of the conflict between science and religion lies in the fact that science takes part in the development of the human species and is, herself, the most distinctive and purest expression of this development, while the religions seek to remain as unchanged as possible, although in doing so they condemn themselves to destruction.

In consequence of the illusion which always located the golden age in the *past*, the priesthood never surmised that their attitude was equivalent to suicide, but they emphasized just that which must ultimately make their position untenable. When the contrast between the old, cherished by the priesthood, and the new, which life brings, becomes too obvious, the phenomenon known as a "Reformation" follows, as for example the reformation of Judaism by Jesus and of Christendom by Luther and Calvin. The only reason why no similar reformation has occurred in Protestantism is that science has gained such influence, even within the church, that the latter has accepted progress as a practical principle. So Protestantism advances along the path where science has led the way—at a variable distance. At present, in the whole Protestant church, science is recognized as the court of last resort. The

church no longer undertakes to say what shall be valid in science, *i. e.*, what shall be true, but, on the contrary, seeks to keep its doctrines in harmony with the established results of science, or, at least, to show that no dis-harmony exists.

The root of the irresistible power of science lies therein, that she is, in fact, in possession of the truth. Certainly not of *all* truth, and still less of the absolute truth; but all of the truth which exists in our world is in the possession of science. This possession can never grow less, but is bound ever to increase.

What is truth?

To this question Ostwald replies:

Truth is that which makes possible prediction of the future. If a man says he fell down yesterday while alone, it is impossible to determine the truth of the statement and his story must forever remain in that uncertain limbo where the distinction between true and false is lacking. If, however, he says: "To-morrow I shall go to Chicago," it is perfectly feasible to test the truth of the affirmation by observing the man on the following day.

The lesson which the illustration teaches is a general one. In strictness, truth exists only as regards the future, since only in the future can we exercise trustworthy control. Although, as to the past, we have many witnesses and traces, nevertheless our conclusion from them has only the character of a probability, and floats somewhere between truth and falsehood, although sometimes very near the former. The truth of an allegation with regard to the future can, in general, be positively settled. Moreover, we have no interest in the past as such, since we can not change it for better nor for worse. We can change the future and it only. Hence, we call that truth which enables us to have a sure influence on the future. Many cases indeed exist where we wish to know the truth about the past, but such truth interests us only in so far as it enables us to exert a defined influence on the future. Whether snow fell February 3, 1325, on the spot where my house now stands has for me no importance, because, for me, nothing depends upon it. But if I had information of the qualities of my antecedents for several generations back, it *would* interest me, for the reason that it would give me knowledge of my own mental and

moral make-up and would assist my self-culture. Self-culture is, however, equivalent to regulation of my conduct in the future. All our fellow men are able to predict the future more or less, in the measure that they possess science. When the domestic lights a fire in the stove of a winter morning, she goes through a series of manipulations, which of themselves produce no heat, on the sure prediction that her labors in carrying coal, chopping kindling, and striking a match will result in a warm room.

When an ocean steamer is to be built at a cost of \$15,000,000, the capitalists risk that sum on the prediction of engineers that if such and such be done, a steamer of well-defined capacities will be the outcome.

We are already in possession of so great a body of truth that no man can know one hundredth part of that which mankind as a whole has. On looking over the field of what science has accomplished for the amelioration of human life, we are impelled to ask: "How has science solved such problems and conferred such benefits?" Science is the systematized knowledge of mankind. The science which deserves the name is a knowledge of the future. How do we arrive at this knowledge of the future?

The answer is familiar. Science has at disposition a great number of so-called "laws," that is knowledge of the interdependence of occurrences. If we know that whenever A happens, B will follow, we have gained two things. If A occurs without act of ours, we can predict the coming of B and so arrange our lives that B will be as advantageous as possible for us, or as little injurious. On the other hand, if we can influence the occurrence of A we will avoid A when B is injurious, or produce A in the reverse case.

Science works, then, in two ways. By its help we can prepare ourselves for the future, or, we can prepare the future for ourselves. Neither of these things are done exclusively by man. All living beings have the rudiments of the capacity to see into the future, and even to adapt it to their needs, as, for example, in the case of a certain wasp, which buries along with each egg hidden in the soil, a freshly killed insect, so that the larva may find food at hand. These primitive forms of conduct directed toward the future do not constitute science, because they are not purposive nor

conscious. It is merely necessary to allude to these instinctive acts upon which the existence of the species depends in order to bring clearly to the understanding the vital importance of science to mankind.

In ancient times work was looked upon as highly undesirable. As a heavy punishment for the disobedience regarding the tree of knowledge, the primal curse was imposed: In the sweat of thy brow shall thou earn thy daily bread. Civilized man has arrived at quite a different attitude from this toward work. To him, a life devoid of labor appears shallow and empty, and he regards those who would wish such an end as comparatively worthless contemporaries. His high aspirations turn not toward a state free from labor, but, rather, toward one in which he may enjoy the happiness of choosing the object and kind of his work.

Even those modern conquerors and despots, that is, the collectors and possessors of giant capital, who in our time are the greatest world-power, are infected with the modern need and impulse to work, and however questionable (or unquestionable) their morals may in other respects be, most of them wear themselves out more in acquiring the source of their power than the humblest of their dependants, and for the most part do not cease to strain their mental powers to the limit in this exacting labor, long after they have amassed fortunes far beyond the most exaggerated possible requirements of the individual.

We perceive that for the man of to-day work has become an instinctive need. We find it difficult to understand the biblical presentation of it as a curse.

Herein we have an illustration of a phenomenon of moment for living beings which can be summarized thus: In the course of evolution the necessities of life develop into the happinesses of life. Those beings in whom pleasurable sensations unite with those tasks necessary to life will carry on those tasks better and more completely than will beings who are only brought to labor by force of necessity. Hence, in the competition for existence, or in the course of adaptation, such beings are at an advantage, in comparison with the discontented, and have a better chance to transmit their characteristics. Thereby is established a progressive con-

firmation and intensification of this vitalizing tendency, which gradually becomes a fixed peculiarity of the species.

The case is similar with regard to the taking of food. Eating and drinking belong to the highest ceremonials of a group of men in proportion to the uncertainties and irregularities of the food supply. This custom, along with the sentiment that prompts it, survives, as a consequence of the law of biological inertia, in highly civilized groups, long generations after the conditions which created them have passed away. Thus we still punctuate our festivities of various kinds with banquets, during which the festive spirit usually reaches a maximum.

Again, the decisive function for the continued existence of a species, reproduction, is safeguarded by a strong development of the corresponding emotions. The mode of life and character of most of the higher animals undergo marked changes at the time of mating, and we see such animals instinctively make the greatest sacrifices for the preservation of their young. If we ask how it is with man in this regard, we only have to consider the content of art. Ninety per cent at least of all poetry relates to love, and the personal experiences of most individuals further go to show that the emotions aroused in connection therewith and the feelings of happiness and misery are keener than any other emotions that affect mankind. In this, some men have a different experience, or express themselves doubtfully. These are the *creative geniuses*. They often declare that in hours of greatest productivity they have had a sense of profound or even of inexpressible happiness.

In our day work has, from being a necessity imposed on life, become developed till it has become one of the joys of life. The completeness of this change of feeling varies with the stage of culture of the particular group. Desire for work has become instinctive, especially among those peoples who have longest been subjected to the urgent necessity to labor. It is, accordingly, largely a matter of climate; and we find that, in general, the instinct to work diminishes from high latitudes to the tropics.

Seen from this point of view, work appears as a substantially modern conception. In order to appreciate the full significance of this mental attitude, it will be helpful to turn our attention for a

while to an entirely different field, that of physical science, in which the idea of work (and of its correlate, energy) has begun to play a rôle so predominant as to be in fact the centre and point of departure of our apprehension of life and of the universe.

In the narrowest physical sense, work is exclusively mechanical work, such as that required to move an object. Such work is performed when a locomotive pulls a train or when a man lifts a load. In these cases the work is made up of two factors, first, power or force; second, path or distance. The science of physics teaches us that the work is equal to the power (or force) multiplied by the path (or distance), because the product has the peculiarity that it is equally influenced by any change in either component. If either the force or the distance be doubled, the work also is doubled. In virtue of measuring work in this precise manner, a very important law of nature is arrived at, called the law of conservation of work, or energy. The essence of the law is this, that by no means is it possible to obtain work out of nothing, but only to obtain one kind of work from another kind of work, under the limitation that the total work obtained can never be greater than that used to start with.

According to a familiar anecdote, Archimedes declared that if he had a lever long enough and a place to rest it on he could move the world. He figured that he could increase the force of his effort indefinitely by indefinitely increasing the length of the lever.

Every laborer who uses a crow-bar has experimental knowledge of the effect, which, at first glance, seems incompatible with the conservation law. The apparent discrepancy vanishes when we remember that the short arm of the lever moves less than the actuating hand, so that just in proportion as we increase the force do we reduce the distance through which the force is applied; the work done at the short end of the lever remaining the same as that performed by the hand at the long end. Hence, while Archimedes might indeed move the world, as he imagined, yet the distance through which it moved would be so infinitesimal as to transcend observation.

In a word, we may say that work is not creatable. We must be content with that which is in the world accessible to us. Still, our

whole existence depends on work, in the broader sense. Whenever anything whatever happens, work is consumed, to be transformed into that which distinguishes the new condition from the old. The significance of work, then, is this, it is the bottom principle of life and of everything that happens. In a universe in which there were no work nothing would happen. *Work alone conquers death.*

When Faust, saturated with the pseudoscience of scholasticism, cries out in his despair:

"Geheimnisvoll am lichten Tag  
Lässt sich Natur des Schleiers nicht berauben;  
Und was Sie Dir nicht offenbaren mag,  
Das zwingst Du Ihr nicht ab mit Hebeln und mit Schrauben."

(Nature, secretive in the bright day,  
Suffers no man to snatch her veil aside;  
And what she does not care to tell thee,  
Thou canst not force from her by rack nor screw.)

His utterance, in the light of natural knowledge, shows itself as false. Nature tells man all that he asks; only he must have learned to question her intelligently. How can he learn to do that? There is but one answer, through science. Not through paper science, but through a living knowledge of nature. Not in ancient parchments, but in the fresh well of experience shall we find the knowledge which we need, which is fruitful and a sure guide.

We have seen that work can not be produced from nothing. But how does it stand with the reverse proposition? Can work be annihilated?

The fact is, of course, familiar that in mechanisms of every sort there are seeming losses of work or of "power" as we sometimes incorrectly call it. This is doubtless true, but not the whole truth. It is all we knew of the truth till an original thinker, Robert Mayer by name, came upon the scene early in the forties of the last century, who was not satisfied with this meagre information. The young physician, on the occasion of a journey by sea to the tropics, was assured by an old ship's officer, that the sea-water is always warmer after a severe storm than it was before. This suggestion was enough to arouse in the mind of Mayer a series of questions. Might not the heat be produced by the large amount of work which had been done in raising the waves and which had disappeared? The thought looked like an absurdity to the scientific men of the

day, but, luckily, there were none of these for Mayer to question as his ship lay off the coast of Java, and he followed out the line of thought, undisturbed by prejudices. In the steam engine work is undoubtedly produced. Whence comes it? The steam engine must receive heat in order to run. May not the work it does spring directly from the heat? Work gives heat when it vanishes and conversely, heat generates work in the engine. Are, then, heat and work things which can be transformed into one another, like two chemical compounds, or are they merely different forms or manifestations of one and the same thing?

Filled with these reflections and with the conviction that he had attained a deep insight into the nature of things, Mayer returned home, communicated his ideas to friends and sought to convince them. The mathematicians among them were so impressed by the faulty form in which Mayer put his theory, that they would not listen and paid him no attention, even after he had corrected the error. The professors proved no more amenable. One of them remarked sarcastically, that if all that were so, a bottle of water violently shaken ought to become warmer. Mayer, undeterred by the sarcasm, tried the experiment, the result of which is now so familiar to us as to seem almost axiomatic. It would take us too far aside to relate Mayer's further troubles, the misconception he encountered, the effort made to cure him by shutting him up in an insane asylum, and all the rest of his pathetic, tragic, story.

We now see clearly that in doing mechanical work the *losses* of work, due to friction, result in heat. In a word, friction is a means of converting work into heat, just as a steam-engine is a means of converting heat into work. Incomplete machines are those that transmute part of the work into heat, and the smaller this part is the more perfect we call the machine.

Heat is, however, not the only thing into which work may be converted. It may reappear in the form of electricity, or of light, or of chemical change. All these things, out of which work may arise, or into which it may be changed, we now call energy. While the law of the conservation of work has only a limited and ideal application, that of the conservation of energy is a natural law of universal application, without any limitation or exception. If we

call those amounts of energy *equal*, which arise from one another, we can, as a result of all experience, express the conservation law in the following terms:

Within a closed system, through whose walls no energy can pass in or go out, the total amount of energy remains the same, regardless of what may happen inside the system.

In what light are we to consider this energy? Is it a mere figment of thought, or, is it an actuality? The answer can scarcely be doubtful. That which can not be created by any power of the universe, which maintains itself unaltered in amount in spite of the numberless and protean changes to which it is subjected through all the ages, must be the most real thing we can conceive of. All efforts of adherents of the older view to discredit the reality of energy have been fruitless, so that now it is thought of not merely as a formal thing, but as an essential entity which can be measured, stored, bought, and sold. When you have the storage battery of your electric car charged up and pay for it, what are you getting for your money? The battery is not heavier by the smallest fraction of an ounce. You have not purchased a figment of the mind, nor any mere abstraction, but an absolutely real thing, so many units of energy. You may think of it perhaps as electricity, but this is erroneous, since the charged battery contains its energy in chemical not in electrical form.

Energy is more than a reality. It is the reality. No phenomenon, no effect, is anything but a (more or less transitory) manifestation of energy and, as such, is subject to the energy law.

Only ideal machines convert one form of energy exclusively into one other, desired, form. A plant is a machine which uses the rays of the sun directly for building up its body, a thing man can not do, but it is not a perfect machine, since it does not convert all the solar energy it receives to its own uses. From the human standpoint, a plant is a machine for storing up energy of solar radiation in the form of food for man. We have the data for comparing the energy available to the plant with that stored up. The result of the comparison is striking. The plant stores up in fact less than one hundredth part of the energy it receives. The relation between the total energy received by a machine and that which it utilizes we

call the figure of merit of the machine. This technical expression is but an extension of a colloquial figure of speech, thus, we call an electric generator "good" if it converts 97 per cent of energy received into electric current, and "bad" if it only converts 85 per cent. *In the final summing up, the moral concept of "good" and "bad" must unavoidably rest on the same basis, inasmuch as all things that happen are but energy manifestations.*

Every change in the form of energy is accompanied by a dissipation of part of it, in the form of heat. This loss may be compared with the material losses, in the way of sawdust, chips, etc., which accompany the work of carpenter or stone cutter. We may look on the heat dissipated by machines as an undesirable bye-product. Actual machines fall far short of ideal ones in their figure of merit, that is in their efficiency, but those made by human hands are relatively much less wasteful of energy than those furnished by nature.

The inefficiency of our practical machines, compared with their theoretical efficiency, is a measure of our stupidity or unskillfulness, and in this regard improvement is constantly taking place. All technology is devoted to the conversion of crude energy into forms useful to man. The "figure of merit" in this transformation is a measure of culture in this field. Let us consider what is the scope upward of "technology" in the sense referred to. We have not yet quite got rid of the ancient view of *work*, and hence of technical operations, as being something *low*. It is interesting to recall that Aristotle held the institution of slavery, on which the civilization of Greece and Rome rested, to be inevitably necessary for all time, since he could not picture to himself how the crude labor of grinding corn, pumping water, and the like could be done at all, if not by slaves. Later times have taught us to solve the slave problem by the inanimate agencies of wind, water, and coal, which make unnecessary the lowest forms of human labor. In this illustration we see to what a high degree technical progress has had a humanizing influence by reducing the amount of dehumanizing work. Without technical advances we would have to have slaves today, and we would still be, in the development of social

conscience, ages behind what we are. All the ethics and morals ever thought of never could have effected this. We must eat before we can philosophize!

Formerly the symbol of humanity consisted of man and woman, in the sweat of their brows, digging. The symbol of modern mankind is the man who, by switch-board, steering wheel, or dictograph, expends enormous amounts of mental energy with but trifling muscular effort for the attainment of his ends. This elevation of man, from the level of the ox to that of a higher being, who controls absolutely amounts of energy thousands of times greater than that represented by the muscles of his body; *this* is a great ethical gain which we owe exclusively to technology.

We may also find ethical applications of the idea of "figure of merit," or the efficiency relation. Jesus said of Himself that He came to bring peace into the world. Unfortunately, in the outcome, the sword was more prominent than the dove, and the church, as such, did nearly nothing for the realization of the idea. However, the perception that warfare represents an immense waste of energy, both in actual war and in armed peace, is a view destined to be of decisive effect.

To be delivered from waste of Energy is to be delivered from Evil. Let us take the most abstract of the sciences, Philosophy, and the most abstract branch of it, Logics. What can *that* have to do with transmutation of energy or with improvement of efficiency? Logic has for its subject, the laws of thought, and for its object, the avoidance of defective thinking. Let us suppose its object so far attained that only very few individuals are any longer guilty of drawing erroneous conclusions. Who can guess what a colossal amount of wasted energy would be eliminated if men almost always thought correctly? And also, if all men were noble and virtuous in their dealings? Then, all those energies now expended for judiciary, for punishment, for police, and for government would be set free to use for higher ends.

Ostwald emphasizes the ethical side of all these considerations and condenses the whole into a principle called by him the Energetic Imperative, valid in all phases of our lives, technical, intellectual, ethical.

"WASTE NO ENERGY, MAKE USE OF IT!"

We know energy in two states or conditions. In one of these it is free to do work, or to be transmuted. In the other one it is in a dissipated state, like a cup of water poured in the sand, and is not available for use. It we call "bound energy." We are, then, expressing the facts of observation in saying, "any given amount of energy consists of two parts, free and bound."

Now, in every process of any kind, a portion of the free energy becomes bound, but never does any part of the bound energy become free. Everything of which we have knowledge as happening is subject to this law. Hence, the utmost limit of human achievement is, that we should seize a part of this ceaseless river of free energy (mainly from the sun) flowing by us to the sea of dissipation, and divert it to human uses. We can never increase its amount, but by ignorance or maladroitness we may waste or destroy some of that part which is available to man by facilitating instead of reducing its dissipation. Each of us is, then, made a trustee of that single working capital, that foundation of our collective possibility of living, and his value to mankind is measured by the proportion of total free energy which he takes from the general stream and applies to the benefit of mankind. If, however, by carelessness or misuse he allows the free energy which is under his control to become dissipated, he becomes guilty of a crime against the general welfare which can never be made good, because dissipated energy can never again be converted into free energy. It is the sin against the energetic imperative and has the qualities of unforgivability and irrevocability which have been ascribed to the sin against the Holy Ghost.

The rule of natural law is much more "humane" than that of man-made law, although infraction of the former is indeed punished, inasmuch as the life of each individual is rendered more arduous and unpleasant in proportion to his aberration from the natural laws of vital phenomena. But these laws are not something imposed from without. They form part of the very texture of his being. He only needs to see himself rightly, to be impressed, not only with the inevitableness of natural laws, but also with their desirability. The law that the straight line is the

shortest distance between two points does not trouble us, since we do not have to go that way unless we prefer it. But we have every ground for satisfaction in the circumstance that we know this law and have since early childhood learned its practical application, for this knowledge enables us to reach our destination by the shortest path and so puts us in a position to act in harmony with the energetic imperative and to visit our friends without undue waste of energy!

Ostwald states that he learned not to force himself to work when he did not feel inclined toward it, and so accomplished much more in the end, because there was no waste of energy in overcoming the resistance of disinclination; and argues that the aim of our practical social ideals should be, so to arrange *all* labor as to conduct it in like manner. This would conduce to the greatest happiness of the greatest number, and all would be working to the greatest advantage, since working voluntarily.

The energetic imperative requires, in fact, that we should remove out of our lives and those of our fellow men every compulsion, every opposition to individual preference so far as is compatible in any way with living together.

To the natural philosopher, natural laws are not commands, but sign-posts, whose purpose and use is to show him the way to a truer and fuller life and to inner content; and he can not fail to desire to see the social order conform to this type so far as possible.

The ethics of the New Testament is generally and rightly thought to attain its highest point in the injunction: "Love thy neighbor as thyself." One is nevertheless compelled to ask whether *love* can, in fact, be the subject of a command or injunction. *Love*, is it not the freest and most personal thing there is? The natural philosopher must recognize the existence of an incompatibility here and change the content of this conception as science has changed the concept of law. A natural law is not a proscription but a transcript, a simple statement of how things actually are. So, in the ethics of the natural philosopher, the doctrine of the conduct of man toward man must have, not the character of a juridical law, but of a natural one, one which shall instruct us, which shall inform us, as men among men, how we can live a

peaceable, efficient, and happy life. And if, perchance, on *this* path we meet love, it will come to us not as a thing prescribed but as an incident and as the most natural and inevitable thing in the world. The road that leads from an insight to a sentiment is often long, but education helps, self-education in case of the more competent, for the rest, education of the children's school type. But by opening our eyes we can find love already present, without either command or education. First of all, self-love, in every living being. Not by the most exacting ethics will self-love be objected to, so long as each individual is isolated from the others. But under these conditions there can be no ethics, in the broadest sense. When the life lines of two beings cross one another, conflict begins. It is the conflict for existence, in which there is no ethical content whatever. On the contrary, it is the direct source of that which we call evil in the world. Simultaneously therewith good also begins to appear.

Deep is the riddle that comes with life, for with life comes the function of reproduction, so that through the activity of each creature a second being comes into the field, which is, to the first, a competitor and an enemy. To ensure perpetuation of the species, each being of the species must, through its offspring, contribute to the keenness of the competition which he, himself, must contend against. A strange situation!

Further, the functions involved in the perpetuation of the kind are bound up with a complex of instincts and feelings that exceed in power all others, even the love of life. In the simplest organisms, consisting of a single cell, reproduction takes place by division of the cell. There are now two beings where there was but one before, but it is impossible to say which is the parent and which the offspring. If they were self-conscious, we may well imagine that they would only learn by experience that they had become two. Something of this sentiment of identity is to be seen in the feelings of the mother toward the young, in the higher animals and in man. The most elementary form of love is that of the mother toward the child, and it is a direct development from self-love. The cat-mother who defends her kitten with her life, later shows toward it an increasingly unfriendly attitude. With

decreasing dependance of the young life there is a diminution of parental love. Among gregarious animals that find an advantage in living in groups the affectionate relation lasts much longer, but the change of feeling finally comes.

Here, the sources of love lie open before us. Parental love is an elementary phenomenon, resulting from the passing of the instinct of self-preservation from the individual to the species. From the same source arises sexual love and also the bond between members of a family, which makes each ready for a measure of self-sacrifice for the protection of the others. From the family to the tribe, from the tribe to the race, from the race to all mankind, the same process extends and develops and this development is equipollent to and largely identical with the growth of ethics.

Here enters, again, the energetic imperative. If we ask why a family or a group of animals or, specially, of men, hang together, the answer is that it is to their mutual advantage, because it brings in numerous ways an economy of energy in the securing of shelter, food, and defense. As soon as the group is formed the conduct of each member must adapt itself to the requirements of the group. Those whose behavior is most beneficial to the group are highly esteemed and their conduct becomes a pattern for others. Those who have not modified their individualistic instincts to conform to the standards of the group are treated worse, or may even be punished or turned adrift. Often one individual of pronounced individualistic instincts appears, who combines therewith great abilities and personal force. He may subordinate the others and compel them to serve his personal interests. The condition thus created, if it continues long enough, gives rise to an ethics in which obedience to the ruler appears as the greatest virtue, and opposition to his will as the most heinous offense. Out of this condition, according to our author, grows the type of morals presented by the higher religions and summed up in the injunction, love God above all, and thy neighbor as thyself. This is the moral system of an oppressed folk, who give to Caesar what is Caesar's and who contrast their joyless lives on this earth with the higher existence hoped for early in the future, for which they seek to prepare by the exercise of love toward those who are to be their fellows for

all eternity. Ostwald lays stress upon the point, that the foundation of this morality has been shaken by the fact that the kingdom of heaven, expected so soon, has not as yet put in an appearance.

The demands of the present will, however, not be denied, and under their pressure a new morality has arisen which is unacknowledged, and which contains the living elements of the old, adapted to the changed environment of today.

As for love, it is an instinct which has grown to be a moral necessity—a social compulsion which has been so fully absorbed into the individual consciousness as to assume the character of love. Rephrasing the old injunction, to meet modern needs, we find the new form of the ethical ideal to be:

“Love thy neighbor in proportion to his social worth.  
Love thy people and mankind more than thyself.”

In closing, it only remains to say that the speaker realizes full well how fragmental and inadequate his presentation has, of necessity, been and to crave your indulgence for its shortcomings.

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